Stimulated echo prepared balanced SSFP with variable T2* and T1 contrast

F. Fidler[1] and P. M. Jakob[1,2]

[1]MRB Research Center for Magnetic Resonance Bavaria, Würzburg, Germany, [2]Dept. of Experimental Physics 5, University of Würzburg

Introduction: Purpose of this work was to provide a stimulated echo method that combines flexible T_2* and T_1 contrast and yields higher SNR than conventional low-flip-angle readout-methods. The proposed method uses a modified STEAM preparation in combination with a modified, high flip-angle balanced SSFP readout (steSSFP) to obtain variable T_2* or T_1 contrast or a combination of both.

Methods: Stimulated echo preparation as shown in figure 5 using two 90°-pulses was modified by adding a single additional dephasing gradient G_1 in slice direction. Readout was done by a balanced SSFP imaging module using high flipangles > 30° which was modified by additional rephasing gradient G_2 and dephasing gradient G_3 in slice direction to achieve balanced gradient conditions. The method was implemented on a 1.5T whole body scanner (Siemens Vision, Erlangen, Germany) and performed on phantoms and healthy volunteers.

Results: Figure 1 shows a steSSFP image with almost no resulting T_1 and T_2* weighting. In comparison, figure 2 and figure 3 show corresponding steSSFP images with additional T_2* ($T_{E(eff)}$ = 40 ms) and T_1 contrast (T_S = 1000 ms) which was achieved by varying the timing of the STEAM preparation. A reference image with standard balanced SSFP acquisition respectively is shown in figure 4.

Conclusion: The proposed STEAM method offers variable T_2* and T_1 contrast of stimulated echoes using high flip angle readout and yields therefore higher SNR than conventional low-flip-angle readout methods. This advantage is combined with the imaging speed of the balanced SSFP imaging readout. It can be easily implemented on every clinical scanner.
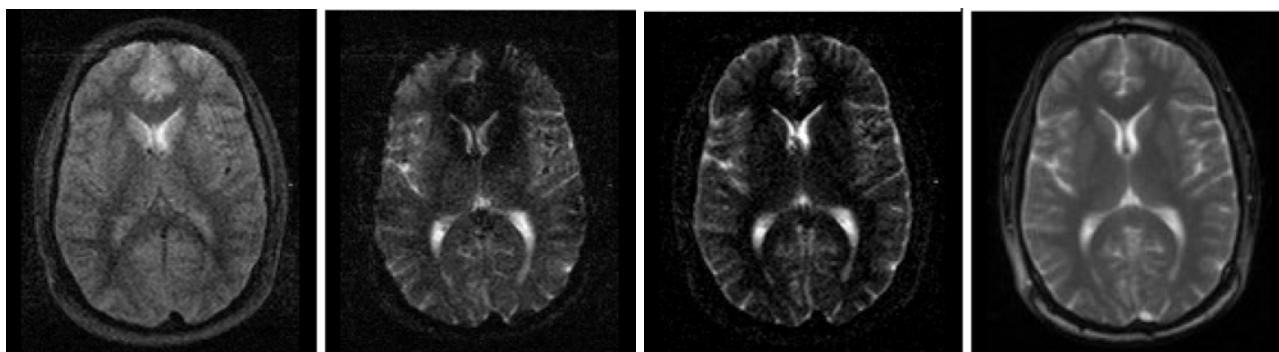

Figure 1: Stimulated echo prepared balanced SSFP (steSSFP) image with almost no T2* and T1 weighting.

Figure 2: T2* weighted steSSFP image with TEeff = 40 ms.

Figure 3: steSSFP image with T1 weighting (TS = 1000 ms).

Figure 4: Reference image with standard balanced SSFP.

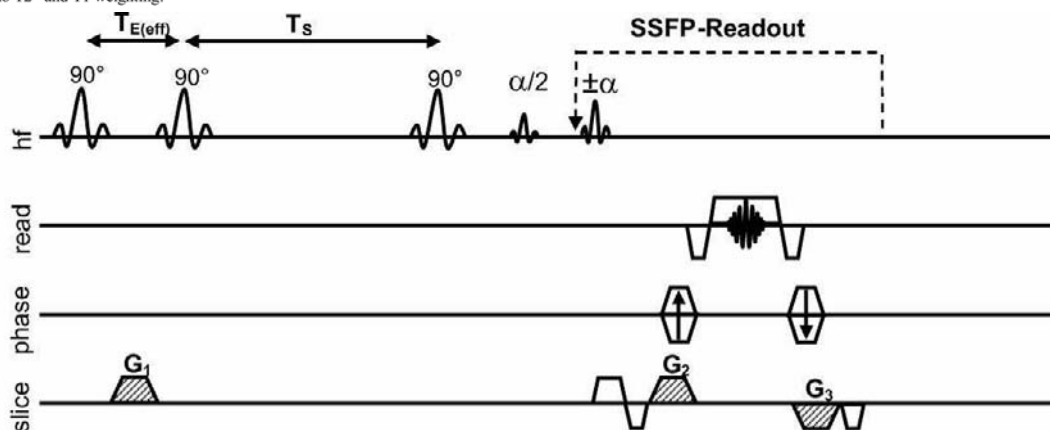Figure 5: Schematic imaging sequence showing stimulated echo preparation with SSFP readout. All Gradients $G_1 - G_3$ have the same area.